Geophysical Research Abstracts
Vol. 12, EGU2010-6791, 2010
EGU General Assembly 2010

Recharge under irrigated cropland versus non-cultivated clayey soils overlying sands of the Mediterranean Coastal Aquifer in Israel

Daniel Kurtzman (1) and Bridget Scanlon (2)

(1) Agricultural Research Organization, Institute of Soil, Water and Environmental Sciences, Bet Dagan, Israel (daniel@volcani.agri.gov.il, 972-3-9604017), (2) The University of Texas at Austin, Bureau of Economic Geology, Jackson School of Geosciences, Austin, Texas, USA (bridget.scanlon@beg.utexas.edu)

Recharge mechanisms (e.g. uniform versus preferential flow) can play an important role in controlling groundwater quantity and quality. Sixty percent of agricultural lands over the Israeli Coastal Aquifer are montmorillonite-rich clays that overly coarser grain material (∼90% in the southern part of the aquifer). Therefore, understanding groundwater recharge, through this typical soil profile, is important for aquifer management. Groundwater salinity and water levels has increased significantly in the south-eastern part of the aquifer underlying this soil profile since the 1980's. Average annual precipitation in this region is 480 mm/yr which occurs only at winter (∼ October – March). Field crops in this area are irrigated usually from May to August with 250 – 550 mm/yr of treated wastewater (∼350 mg/liter chloride).

Soil cores of deep profiles (∼10 m) from non-cultivated and irrigated cropland from this area were used to estimate matrix recharge rates. Soil samples of deep unsaturated zone under non-cultivated land were found to be very saline (average 4800 mg/liter chloride related to pore-water in samples deeper than 3 m). Both chloride mass balance applied to deep-unsaturated zone data and independent 1-D unsaturated flow models calibrated to soil texture and moisture content data, indicate that matrix recharge rates are extremely low (< 3 mm/yr). Pre-modern-cultivation groundwater-chloride data and groundwater balance considerations imply an average recharge of 50 - 70 mm/yr. It is suggested that preferential paths conduct fresh water from the surface to the water table under non-cultivated land in this area, and recharge could not be estimated from soil-core data.

Under irrigated cropland deep soil-core where less saline (average 1100 mg/liter pore-water chloride). Application of the chloride mass balance approach to deep-unsaturated-zone data resulted in recharge rates of 130 – 170 mm/yr, which were simulated consistently with moisture content observations under irrigated plots. These recharge rates are also consistent with groundwater-balance recharge rates under irrigated land and recharge estimations based on unsaturated-zone data made under coarser grain soils in this aquifer. Therefore recharge through soil matrix is considered the dominant recharge mechanism under irrigated cropland, and can be estimated from soil-core data.

It is suggested that cultivation and summer irrigation, which eliminates the native vegetation and destroys the soil's cracked structure, change the dominant recharge mechanism from preferential to matrix flow. An approximation of the average total recharge rate (including matrix and preferential flow) and chloride concentrations of the recharging water in this region are: 60 mm/yr with 250 mg/liter chloride under non-cultivated land, and 150 mm/yr with 1100 mg/liter chloride under irrigated crop land (500 mm/yr irrigation of treated wastewater). Changing from preferential flow under non-cultivated land to matrix flow under cultivated land along with increased salt inputs from irrigation water increased groundwater levels and salinity and has implications for transport of other contaminants, especially in areas irrigated with treated wastewater.